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CLAIMS

1. A particle of  $\text{TiO}_2$  or  $\text{ZnO}$  which has been doped with one or more other elements such that the concentration of dopant in a surface of the particle is greater than that at a core of the particle.  
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2. A particle according to claim 1 which is coated with a discontinuous layer of hydrophilic or hydrophobic material.
- 10 3. A particle according to claim 2 which is coated with hydrophobic polymer.
4. A particle according to claim 2 which is coated first with an oxide of aluminium, zirconium or silicon and then with a long chain carboxylic acid salt.  
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5. A process for preparing a particle as claimed in any one of the preceding claims which comprises placing a particle of  $\text{TiO}_2$  or  $\text{ZnO}$  in contact with a solution or suspension of a salt of the dopant for a time insufficient for the concentration of dopant salt in the core of the particle to reach that at its surface and then baking the resulting particle.  
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6. A process according to claim 5 wherein the particle is based at a temperature of at least  $500^\circ\text{C}$ .
- 25 7. A particle according to any one of the claims 1 to 5 whenever prepared by a process as claimed in any one of claims 5 or 6.
8. A UV sunscreen composition suitable for cosmetic or topical pharmaceutical use which comprises: (a) one or more organic components which are photosensitive and/or which are susceptible to degradation by another  
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ingredient of the composition and/or by undoped  $\text{TiO}_2$  and/or by undoped  $\text{ZnO}$ ; and (b)  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has been surface doped with one or more other elements.

- 5 9. A composition according to claim 8 which is an aqueous formulation and the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is only surface doped.
10. A composition according to claim 8 or 9 which is an oily formulation.
- 10 11. A composition according to claim 8 or 9 which is an oil-in-water or water-in-oil formulation.
12. A composition according to claim 11 wherein the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is present in both phases.
- 15 13. A composition according to any of claims 8 to 12 wherein the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is coated with a discontinuous layer of hydrophilic or hydrophobic material.
- 20 14. A composition according to claim 13 wherein the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is coated with a hydrophobic polymer.
15. A composition according to claim 13 wherein the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is coated first with an oxide of aluminium, zirconium or silicon and then with a long
- 25 chain carboxylic acid salt.
16. A composition according to any of claims 8 to 15 wherein one or more of the said organic components is a UV sunscreen agent.

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17. A composition according to claim 16 wherein the organic sunscreen agent absorbs UV light in the UVA region.
18. A composition according to claim 16 or 17 wherein the organic sunscreen agent is a paraaminobenzoic acid, ester or derivative thereof, a methoxy cinnamate ester, a benzophenone, a dibenzoylmethane, an alkyl- $\beta$ - $\beta$ -phenyl acrylate, a triazine, a camphor derivative, an organic pigment, a silicone based sunscreen agent or 2-phenylbenzimidazol-5 sulphonic acid or phenyldibenzimidazol sulphonic acid.
19. A composition according to any of claims 8 to 18 which contains one or more of a fatty substance, organic solvent, silicone, thickener, demulsant, UVB sunscreen agent, antifoaming agent, moisturising agent, perfume preservative, surface activation filler, sequestrant, anionic, cationic, nonionic or amphoteric polymer, propellant, alkalising or acidifying agent, colourant or metal oxide pigment.
20. A composition according to any of claims 8 to 19 which is a sunscreen.
21. Use of a doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim to reduce the concentration of one or more organic UV sunscreen agents or other ingredient which is photosensitive and/or is degraded by another ingredient in a UV sunscreen composition.
22. A process for increasing the effectiveness of an organic UV sunscreen composition which comprises one or more components which are photosensitive and/or are susceptible to degradation by another ingredient of the composition and/or by undoped  $\text{TiO}_2$  and/or by undoped  $\text{ZnO}$ , which process comprises incorporating into the composition a doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim.

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23. A process for reducing the production of a toxic compound in a UV sunscreen composition which process comprises incorporating therein doped  $\text{TiO}_2$  and/or  $\text{ZnO}$  as defined in any preceding claim.
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24. A composition which comprises an amount of one or more organic or inorganic components which are photosensitive and/or which are degraded by another ingredient of the composition and an amount of  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has been doped at least on or in a surface thereof with one or more
- 10 other elements.
25. A composition according to claim 24 which has a rate of deterioration of a UV light-sensitive physical factor at least 5% less than that of a composition having the same formulation except that it does not contain the said  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has been doped with a second element.
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26. A composition according to claim 25 wherein the physical factor is tensile strength.
- 20 27. A composition according to claim 25 wherein the physical factor is colour.
28. A composition according to any of claims 8 to 27 which contains  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has not been doped, optionally as  $\text{TiO}_2$  and/or  $\text{ZnO}$  particles which have not been doped.
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29. A composition according to claim 28, wherein the said  $\text{TiO}_2$  and/or  $\text{ZnO}$  is present as pigment.

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30. A composition according to any of claims 8 to 29 in the form of a coating on and/or an additive in a polymeric material, which material is thermoplastic, or thermosetting or photosensitive.
- 5 31. A composition according to any of claims 8 to 30 which is in the form of a three dimensional article, or is in the form of a film, or is in the form of a photographic film, or is in the form of a coating composition, or is in the form of a paint or varnish.
- 10 32. A self-supporting polymeric composition intended to protect a composition adjacent thereto from the adverse effects of light which comprises  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has been doped at least in or on a surface thereof with one or more other elements or reduced  $\text{ZnO}$ .
- 15 33. A composition according to claim 32 wherein the  $\text{TiO}_2$  and/or  $\text{ZnO}$  is present in a surface layer.
34. A composition according to claim 33 wherein a non-surface layer thereof is not wood.
- 20 35. A composition according to claim 33 or 34 wherein a non-surface layer thereof is synthetic.
36. A varnish composition which comprises  $\text{TiO}_2$  and/or  $\text{ZnO}$  which has been doped at least in or on a surface thereof with one or more other elements or reduced  $\text{ZnO}$ .
- 25 37. A composition according to any one of claims 32 to 36 which has one or more of the features of claims 25 to 31.

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38. Use of a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim to reduce the concentration of one or more light stabilisers in a polymeric composition.
39. Use of a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim to reduce the rate of deterioration of a light-sensitive physical factor in a polymeric composition.
40. A process for improving stability of a physical factor of a polymeric composition, which comprises one or more components which are photosensitive and/or are degraded by another ingredient of the composition which process comprises incorporating into the composition a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim.
41. A composition suitable for veterinary, agricultural or horticultural use which comprises at least one organic veterinarily, agriculturally and/or horticulturally active compound, and titanium dioxide and/or zinc oxide which has been doped at least in or on a surface thereof with one or more other elements.
42. A composition according to claim 41 wherein the active compound is a herbicide, fungicide, insecticide, acaricide, miticide or rodenticide.
43. A composition suitable for household use which comprises at least one organic biocide, and titanium dioxide and/or zinc oxide which has been doped at least in or on a surface thereof with one or more other elements.
44. A composition or particle or process or use according to any preceding claim wherein the dopant is manganese, selenium, cerium, chromium, vanadium or iron.

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45. A particle or composition or process or use according to any preceding claim wherein the dopant is  $Mn^{2+}$  or other manganese, or is  $V^{4+}$ .
46. A composition or particle or process or use according to any preceding claim wherein the dopant is present in an amount from 0.05 % to 10 mole %.
47. A composition or particle or process or use according to claim 46 wherein the dopant is present in an amount from 0.5 to 2 mole % by weight.
48. A composition or particle or process or use according to any preceding claim in which the doped oxide is doped titanium dioxide.
49. A composition or particle or process or use according to any preceding claim wherein the titanium dioxide is in rutile form.
50. A composition or process or use according to any of claims 8 to 49 which contains reduced zinc oxide.
51. A composition according to any preceding composition claim which comprises 0.5 to 20 mole % by weight of the doped titanium dioxide and/or zinc oxide.
52. A composition or particle or process or use according to any preceding claim wherein the doped or reduced oxide has a particle size from 1 to 200 nm, preferably 1 to 100 nm; or from 100 to 500 nm.
53. A composition according to claim 42 wherein the active compound is an insecticide.

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54. A composition according to any preceding composition claim which contains one or more of a filler, organic solvent or surfactant.
55. A composition according to any preceding composition claim which is in the  
5 form of an aqueous or non-aqueous liquid, a powder, granules or tablet.
56. Use of a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim to reduce the concentration of one or more veterinarily, agriculturally and/or horticulturally active compounds in a composition suitable for veterinary,  
10 agricultural, horticultural or household use.
57. Use of a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim to increase the shelf life of one or more veterinarily, agriculturally and/or horticulturally active compounds in a composition suitable for veterinary,  
15 agricultural, horticultural or household use.
58. A process for increasing the effectiveness of a composition suitable for veterinary, agricultural, horticultural or household use which process comprises one or more organic veterinarily, agriculturally or horticulturally  
20 or household active compounds, which comprises incorporating into the composition a surface doped  $\text{TiO}_2/\text{ZnO}$  as defined in any preceding claim.
59. A process for treating an agricultural or horticultural species at a locus which process comprises treating the locus with a composition as claimed in any  
25 preceding composition claim.
60. A particle or composition or process or use according to any preceding claim in which the mole ratio of dopant to host metal at the surface is 2-25 to 98-75.



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61. A particle or composition or process or use according to claim 60, in which the mole ratio of dopant to host metal at the surface is 8-75 to 92-25.
- 5 62. A particle or composition or process or use according to any preceding claim in which the concentration of dopant in a surface of the particle is greater than in the bulk of the particle.
- 10 63. A particle or composition or process or use according to any of claims 1 to 61 in which there is no dopant at the core of the particle and/or in the bulk of the particle.
64. A particle or composition or process or use according to any preceding claim in which a dopant is present in the bulk of the particles, and wherein the bulk dopant is different from the or each surface dopant.
- 15 65. A particle or composition or process or use according respectively to claims 1; 8, 24, 32, 36, 41 or 43; 22, 23, 40, 58 to 59; or 21, 38, 39, 56 or 57 substantially as herein described, with reference where appropriate to any of the accompanying drawings.
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